

CHIMERA

(Combined Heating and Magnetic Research Apparatus)



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CHIMERA is a unique component loading machine, designed to test prototypes in the simultaneous extreme temperature, heat flux and electromagnetic environment representative of fusion power reactor conditions. The systems can also be used independently making them suitable for non-fusion applications.

OBJECTIVE

To provide a facility for design development and risk mitigation for fusion component 'modules' (e.g. first wall, blanket, divertor and diagnostics). This capability will be introduced in phases.

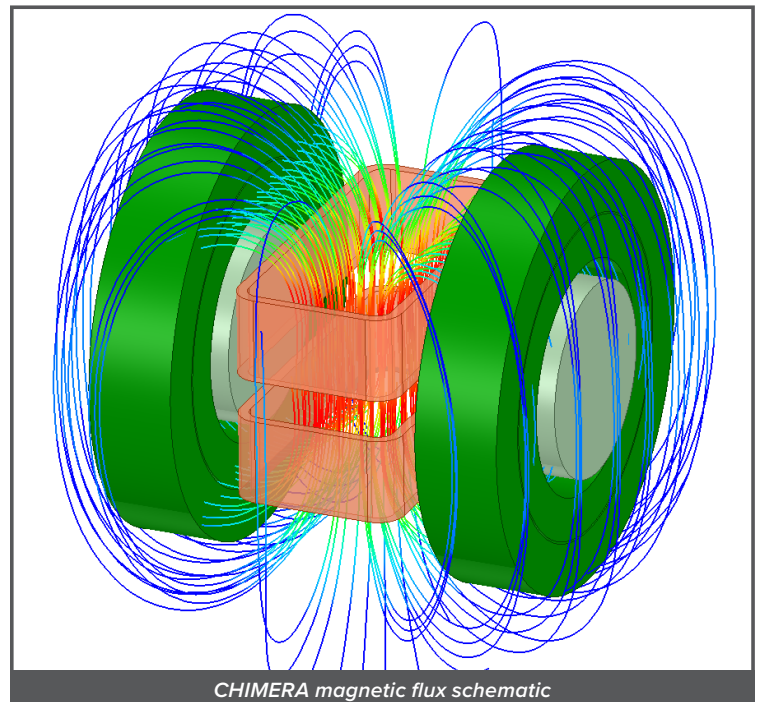
CHALLENGES

In-vessel component challenges:

- ▶ High heat flux
- ▶ Electromagnetic loads
- ▶ Thermal cycling and creep failure
- ▶ Complex, bespoke and high-risk manufacturing
- ▶ There is currently no facility dedicated to testing under electromagnetic loads including tokamak disruptions

SYSTEM SPECIFICATION

- ▶ Component modules up to size of 1:1 ITER TBM (Test Blanket Module) mock-ups (~ 1.7 x 0.6 x 1.0m)
- ▶ Water cooling 200°C, 15 bar or up to 320°C, 155 bar
- ▶ Testing chamber for tests in vacuum (1×10^{-5} mbar) or inert/air
- ▶ Surface heating capable of 0.5-1 MW/m² over ~1m²
- ▶ Simulated volumetric heating – power up to 700 kW
- ▶ High heat flux surface heating in localised areas – 20 MW/m² over 1500mm²
- ▶ Static magnetic field testing, with peak field 4 Tesla
- ▶ Magnetic impulse simulating a plasma disruption with $dB/dt \sim 12$ T/s
- ▶ Testing of blanket components with static liquid PbLi
- ▶ Provision for addition of a PbLi circulation loop and/or gas cooling as a future upgrade



CHIMERA magnetic flux schematic

CASE STUDY

Divertor target development

DEMO (Demonstration Fusion Power Station) will rely heavily on predictive modelling for design.

Diagnostic data will be sparse and therefore modelling promises lifetime/realtime monitoring.

Development requirements:

- ▶ Data driven design, exploiting wealth of data and reducing reliance on human experience/judgement
- ▶ Component surveillance in-service and associated digital twins
- ▶ Models that have provenance in high quality experimental data
- ▶ Highly instrumented testing, enabling thorough diagnosis of performance and failure modes and abundant engineering data

The UK Atomic Energy Authority's mission is to lead the commercial development of fusion power and related technology, and position the UK as a leader in sustainable nuclear energy.



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Contacts

Find out more
www.gov.uk/ukaea

Once completed, this facility will be open to both industry and universities. We welcome all enquiries.

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